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15. No step of calculation has yet been made in reference to the symbolical variation of arguments.

16. No calculation is yet made for that side of the final equation which contains the disturbing force as a factor.

In any future Report which it may appear desirable to place before the Society, there will be no occasion to repeat any part of the explanation of methods given here, and it may be anticipated that the statement of the step which the operations may have reached will be very brief.

Royal Observatory, Greenwich,
1875, *February* 6.

Observations of the Satellites of the Planet Uranus, made at Birr Castle, during the years 1872, 1873, *and* 1874.

By the Earl of Rosse.

The following observations of the Satellites of the planet *Uranus*, made with the reflector of six-feet aperture at Birr Castle, though for several reasons not as satisfactory as might be desired and might be obtained with that instrument, may perhaps be of some value as a contribution to knowledge in a department of astronomy in which so few have as yet worked.

The shortness of the time (40 minutes) available each night for the observation of the planet with the 6-foot instrument, the atmospheric disturbance so often a source of annoyance in using so large an aperture, the unsuitability of the micrometer for the work, and to a certain extent also the almost unavoidable deterioration of the polish of the mirrors in the course of working, which probably increased the diffused light round the planet, combined to detract from the accuracy of the observations, and to render the detection of the inner satellites difficult.

My late assistant, Dr. Ralph Copeland, has compared the observed places of *Oberon* and *Titania* with those which he has calculated from Dr. von Asten's definite circular Elements given in Vol. xviii., No. 5, page 26, of the *Memoirs* of the Imperial Academy of Sciences of St. Petersburg. The differences between calculation and observation are given in the column headed (C.—O.). The observations made by Dr. Copeland and myself are distinguished respectively by the letter C. or R.

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Oberon.

Date.			Sid. Time. h	m	Posi-tion. °	No. of Measures.	Dis-tance. "	No. of Measures.	C.–O. Posi-tion. °	C.–O. Dis-tance. "	Observer.
1872	Jan.	13	8	20	324·9	2	...	...	−1·3	...	C.
,,	,,	15	8	14	259·0	2	...	...	−0·6	...	C.
,,	,,	18	8	15	179·3	1	...	...	+1·3	...	C.
,,	,,	19	8	26	161·9	2	...	...	−1·4	...	C.
,,	Feb.	3	8	16	122·5	4	...	...	−0·6	...	C.
,,	,,	5	8	9	53·4	4	...	...	0·0	...	R.
,,	,,	6	8	17	30·3	3	...	...	−3·8	...	R.
,,	,,	7	8	23	4·8	5	...	...	+0·4	...	C.
,,	,,	10	8	24	294·3	3	...	...	−0·8	...	R.
,,	,,	12	8	19	226·4	2	...	...	−0·6	...	R.
,,	Mar.	2	8	19	89·9	10	...	...	−2·6	...	C.
1873	Jan.	16	8	40	174·3	2	...	...	−1·2	...	C.
,,	,,	,,	8	48	...	...	44·93	2	...	+0·29	C.
,,	Feb.	6	8	42	343·0	1	43·81	1	−5·2	−1·49	R. & C.
,,	,,	19	8	35	350·0	3	...	...	−2·3	...	C.
,,	,,	,,	8	32	...	3	41·98	2	...	+2·60	C.
,,	,,	20	8	44	325·5	2	36·16	2	+0·1	+2·95	C.
1874	Jan.	16	8	56	144·6	1	35·49	1	−6·6	+3·01	C.
,,	,,	20	9	3	18·4	2	43·47	2	−2·6	+1·24	C.
,,	Feb.	3	8	46	9·8	2	44·70	2	−2·3	+1·43	C.
,,	,,	4	8	49	352·8	2	44·80	2	−2·0	−0·34	C.
,,	,,	18	9	4	340·7	1	40·83	1	0·0	+0·62	R.
,,	,,	21	9	3	235·9	1	...	...	+1·9	...	R.
,,	,,	,,	9	5	...	...	36·47	1	...	−4·23	R.
,,	Mar.	7	9	4	221·9	3	...	...	−0·4	...	R.
,,	,,	,,	9	2	...	...	35·03	2	...	+0·18	R.
,,	,,	18	8	57	316·3	2	34·55	2	−1·2	−0·95	C.

Titania.

1872	Jan.	13	8	26	39·2	1	...	...	−2·6	...	C.
,,	,,	15	8	16	334·6	2	...	...	−6·9	...	C.
,,	,,	18	8	12	191·2	1	...	...	+3·3	...	C.
,,	,,	19	8	26	165·4	2	...	...	−1·7	...	C.
,,	Feb.	3	8	21	257·6	5	...	...	−0·8	...	C.
,,	,,	5	8	9	176·8	4	...	...	+1·0	...	R.
,,	,,	6	8	20	139·6	4	...	...	+5·0	...	R.

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Date.			Sid. Time.		Position.	No. of Measures.	Distance.	No. of Measures.	C.–O. Position.	C.–O. Distance.	Observer.
			h	m	°		″		°	″	
1874	Feb.	7	8	21	97·9	4	...	...	–0·7	...	C.
,,	,,	10	8	24	339·1	2	...	...	–1·6	...	R.
,,	,,	12	8	14	245·0	3	...	...	–2·4	...	R.
,,	Mar.	2	8	16	184·1	10	...	...	–1·0	...	C.
1873	Jan.	16	8	40	272·6	2	...	...	–5·5	...	C.
,,	,,	,,	8	47	...	...	22·64	2	...	+0·66	C.
,,	Feb.	6	8	42	138·1	3	...	...	–5·0	...	R. & C.
,,	,,	,,	8	43	...	...	25·55	2	...	+1·66	...
,,	,,	19	8	36	318·8	3	[29·12]	[1]	–1·7	[–1·09]	C.
,,	,,	20	8	47	263·5	2	18·35	2	–1·5	+5·55	C.
1874	Jan.	16	8	59	309·9	1	24·29	1	–1·8	–0·74	C.
,,	,,	20	9	10	148·8	1	25·69	1	–3·6	+1·36	C.
,,	Feb.	3	8	46	278·4	2	20·90	2	–4·3	+0·52	C.
,,	,,	4	8	52	217·4	2	25·17	2	+1·1	+3·03	C.
,,	,,	18	9	2	12·9	1	31·58	1	–2·5	+3·07	R.
,,	,,	21	8	55	239·4	1	29·11	1	+0·6	–5·13	R.
,,	Mar.	7	8	59	25·6	3	31·68	3	–2·2	+0·05	R.
,,	,,	18	8	55	314·6	2	24·87	2	–2·3	+0·11	C.

Umbriel.

1872	Feb.	6	8	32	302·9	1	...	...	...	...	R.
1873	,,	19	8	46	176·5	2	17·82	2	...	...	C.

Ariel.

1872	Feb.	6	8	28	217·3	1	...	...	...	...	R.
1873	Jan.	16	8	40	197·6	2	...	...	...	...	C.
,,	,,	,,	8	46	...	...	15·38	1	...	...	C.

Notes and Remarks.

1872. Jan. 13. The Satellites very difficult to measure. The diameter of *Uranus* estimated equal to the thickness of the position-wire found = 3″·26 or thereabouts.

,, ,, 18. Sky hazy; speculum in a state of strain.

,, Feb. 3. *Oberon* far brighter than *Titania*. Power 414.

,, ,, 10. All four Satellites seen on the same side of the planet, but only *Oberon* and *Titania* measured.

1873. Jan. 16. Definition at times good. No trace of any markings seen. *Ariel* very difficult to measure, especially in distance. Diameter of *Uranus* = 5″·29 (2 measures).

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1873 Feb. 19. There are two accordant measures of *Titania*, giving the distance = 22″·87 and one making it 29″·12. Probably the former measures are both wrong to the extent of 10 parts of the micrometer-head = 6″·511.
„ „ 20. *Titania* excessively faint; sky hazy.
1874. Jan. 16. *Titania* seen only after some examination. Definition very inferior, but power 625 shows the Satellites better than 414.
„ Feb. 3. Moon shining into mouth of tube.
„ „ 4. Clouds drifting over, but Satellites seen fairly at times. Moon troublesome.
„ „ 18. At 9h. 7m. a faint fixed Star ? was measured. Position 255°·0; Distance 51″·12.
„ Mar. 7. *Oberon* rather fainter than *Titania.*
„ „ 18. A 14-mag. Star 23°·7, 80″·70.

Dr. Copeland remarks that the negative sign predominates in the column headed (C. – O.), and hence our observations of the position-angle deviate from Herr Struve's on the same side as Dr. von Asten has found those of M. Lamont and Messrs. Lassell and Marth to do. In fact, von Asten gives at page 25 the following differences:—

	Oberon.	Titania.
Struve – Lamont	– 1°·78	– 1°·91
Struve – Lassell (1852)	– 1·26	– 2·03
Struve – Marth	– 1·77	– 1·92

and Dr. Copeland finds—

Struve – Rosse	– 1·38 (60 obs.)	– 1·29 (61 obs.)

Great care was taken in the determination of the zero of the position-circle of the micrometer, which was obtained by setting the wires parallel to the diurnal motion of the stars, the telescope being fixed, and referring their position to that of the wires of a collimator firmly fixed inside the tube, of the construction described by Sir J. Herschel.*

Where the night was not calm and otherwise favourable reference to the collimator-wires rather than directly to the equator was adopted, as the more reliable method. The position-angles have all been corrected for the error due to the peculiar arrangement of the axis on which the telescope turns.†

A magnifying power of 414 was generally used, but occasionally the inner satellites could be better seen with a power of 625.

Dr. Copeland found values for the semi-axis major less than those of Struve by 0″·654 for *Oberon* and 1″·389 for *Titania*; but as in the micrometer the distances were measured by coincidence of the apparent centres of the objects with the *internal* edges of

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* See *Outlines of Astronomy*, Art. 204*f.*; also, *Phil. Trans.* 1833, &c.
† See *Phil. Trans.*, 1861, p. 700.

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opaque bars without illumination, it would be hardly possible to avoid systematic error in measuring distances, and thence to arrive at any *very* accurate result as to the mass of the planet; but I may say that $\frac{1}{23577}$ from observations of *Oberon*, and $\frac{1}{24422}$ from observations of *Titania*, are the values he has deduced for the mass.

1875, *March* 1.

Note on the Colour of Uranus. By Captain W. Noble.

Turning back to the records of observations made by me at various and unequal intervals during the last eighteen years, I find my visual impressions of the tint exhibited by the disk of *Uranus* always embodied in the words, "a pale blue disk."

On the night of Tuesday last, however (March 9), on turning my telescope on to the planet at $9^h\ 45^m$ L.M.T., I was at once struck with the apparent alteration in the character of its light, which was much *whiter*, and brighter than I ever remember to have seen it. Nay, there was even the faintest suspicion of *yellow* in it; so thoroughly had every vestige of blueness vanished.

The weather has prevented me from repeating my observation; but I lose no time in publishing it in order that other observers, with superior optical means to my own, may either confirm, or disprove my suspicion.

We are all familiar, by this time, with the remarkable change of colour exhibited by *Jupiter* at intervals; and it would be a curious coincidence were a cognate variation found to exist in this more distant member of our system.

I had *Uranus* under observation from $9^h\ 45^m$ until about $10^h\ 10^m$ L.M.T. with powers of 154 and 255 on my 4·2 in.-Ross Equatoreal; and the change of tint from that which I recollect appeared as marked with the higher power as with the lower one.

Forest Lodge, Maresfield,
1875, *March* 12.